SUMMARY OF REQUIREMENTS IN NASA WORK PACKAGE #2

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Instrumentation

Work package #2 (WP2) has a section in the proposal dealing with measurements of the environment. Figure 1 summarizes the quantities to be measured as well as the instruments to be used. The information on Figure 1 provides only a cursory overview of what has been considered at the time of the proposal. Nevertheless it gives the general ideas and indicates that much work needs to be done to develop specifics. It is important to note that measurements in the field of particles and waves are not part of the proposal. On the other hand, some of the environmental measurements planned and included in the proposal do not fall within the category of contamination. Figure 2 shows some concepts of environment monitoring configurations.

Related Activities

Related activities which are presently pursued at JSC cover mainly three areas: 1) contamination level prediction, 2) measurement of the effect of high energy atomic oxygen on materials, and 3) preparations for the EOIM-3 STS flight experiment.

1) The MOLFLUX molecular flow model is being extensively used for trade studies concerning various contamination issues and combines all major Space Station structural elements and the Space Shuttle Orbiter. The model of the Space Station configuration will be updated as new data become available.

2) Efforts to measure the effects of high energy (5eV) atomic oxygen on various potential Space Station materials are continuing in cooperation with the Los Alamos National Laboratory. Because of the high energies involved, ground-based simulations of orbital effects have, until recently, been very difficult to achieve. A high-energy (5eV) atomic oxygen simulation facility using a CW laser-sustained discharge source is being developed to evaluate a wide range of materials and study the long-term effects of atomic oxygen exposure on typical materials used in Space Station applications. This facility produces a well-collimated beam of 1-5 eV oxygen atoms with fluxes of up to 10^{17} O-atoms/s-cm^2 by using a focused beam of laser energy to produce a high temperature, rare gas plasma in which molecular oxygen introduced upstream of the plasma discharge is dissociated into ground-state atomic oxygen. The reactions of atomic oxygen with Kapton, Teflon, silver, and various spacecraft coatings have recently been studied. The oxidation of Kapton has an activation energy of 0.8 Kcal/mole over a temperature range of 25^{o}C to 100^{o}C at a beam energy of 1.5 eV and produces low molecular weight, gas-phase reaction products (H_2O, CO, CO_2). Teflon has been found to react with $\sim$ 0.1-0.2 efficiency to that of Kapton, and both surfaces show

a carpet-like appearance after exposure to the laboratory O-atom beam. Angular scattering distribution measurements of O-atoms off target surfaces show a near cosine distribution for reactive substrates, indicating complete energy accommodation of the energy with the target material. In comparison, non-reactive surfaces, such as nickel oxide, have shown specular-like scattering, with little accommodation (50%) of the translational energy with the surface.

3) Preparations for the EOIM-3 experiment are continuing. In addition to surface interaction studies, the beam facility at the Los Alamos National Laboratory is being used to calibrate a flight-qualified mass spectrometer for the EOIM-3 (Evaluation of Oxygen Interactions with Materials, third series) STS flight experiment. This experiment will study the interaction of materials with atomic oxygen in the LEO environment and is currently manifested on Space Shuttle mission 42, with launch to occur during July 1990.

SOME PRELIMINARY CONSIDERATIONS ENVIRONMENTAL MONITORING MEASUREMENTS AND INSTRUMENTS FOR WP-2

QUANTITY	INSTRUMENT
CONTAMINATION (Bid)	
Atomic Oxygen	Mass Spectrometer
Low MW Contaminants	Mass Spectrometer
Released Fluids	Mass Spectrometer
Released Fluids	Leak Detection System
Contam. Deposition (Wt.)	Quartz Microbalances
Contam. Optical Effects	Optical Effects Module
Heat Flux	Calorimeters
Pressure	Ionization Gauges
Released Particles	Camera(s)
PARTICLES AND WAVES (Not Bid)	
Particulate Radiation	Crew Dosimeters
"	Station Radn Monitors
Meteoroids and Debris	Not Defined
EMI	Spectrum Analyzers
Plasma	Ion Mass Spectrometer

FIGURE 1

ENVIRONMENTAL MONITOR CONFIGURATION

- **Several Concepts**
  - **Single Palletized Unit With Self-Contained Power and Data Recording, Locatable as Needed (Similar to IECM)**
  - **Single Palletized Unit, Linked to DMS for Power and Data I/O**
  - **Components From Pallet Individually Movable, Feeding Into Data Bus**
  - **Multiple Units, So That Environment Can Be Characterized in Several Places Simultaneously**
  - **Continuous or Intermittent Operation**
  - **Some Components will be Specifically Located at the Location Being Monitored (Dosimeters, Vibration Monitors)**

Figure 2